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Indian Standard

GUIDE FOR EQUIPMENT RELIABILITY TESTING

PART 3 PREFERRED TEST CONDITIONS FOR EQUIPMENT RELIABILITY TESTING

Section 1 Indoor Portable Equipment (Low Degree of Simulation)

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PART 3 PREFERRED TEST CONDITIONS FOR EQUIPMENT RELIABILITY TESTING

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GUIDE FOR EQUIPMENT RELIABILITY TESTING

PART 3 PREFERRED TEST CONDITIONS FOR EQUIPMENT RELIABILITY TESTING

Section 1 Indoor Portable Equipment (Low Degree of Simulation)

0. FOREWORD

0.1 This Indian Standard (Part 3/Sec 1) was adopted by the Indian Standards Institution on 20 October 1986, after the draft finalized by the Reliability of Electronic and Electrical Components and Equipment Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 This standard which deals with the reliability requirements when these are expressed as a success ratio is the third in the series of Indian Standards for equipment reliability testing. To be able to write a detailed reliability test specification and perform a reliability test, the test engineer will need additional information which are dealt with in detail in other standards in this series. A list of standards envisaged in this series (some of which are under consideration) is given on page 12.

0.3 This standard is largely based on IEC Document 56 (C.O.) 102 Fifth draft, Publication 605: Equipment reliability testing, Part 3 Preferred test conditions for equipment reliability testing, Test cycle 1: Indoor portable equipment, Case 1 Low degree of simulation, issued by the International Electrotechnical Commission (IEC).

1. SCOPE

1.1 This standard (Part 3/Sec 1) recommends preferred test conditions for equipment reliability testing for indoor portable equipment with low degree of simulation.

2. INTRODUCTION

2.0 This standard contains preferred test conditions as referred to in **9** of IS : 8161 (Part 1)-1976*. Whenever possible, test cycles should be chosen from among those given in this standard. For applications not covered here, appropriate test cycle should be designed using IS : 8161 (Part 2)-1986*.

2.1 The main object of presenting preferred test conditions is to ensure that equipments with similar applications albeit different in form, fit and function are subjected to the same test conditions. This also facilitates comparisons.

2.1.1 The test cycle provided here is not intended to replace ordinary tests such as qualification tests, functional performance tests and environmental tests.

2.1.2 These test cycles are sequences of different operating and environmental conditions which are based upon actual use conditions, as defined, for example, by the relevant product specification.

2.2 Test cycles are presented here with different degrees of simulation of use conditions. A cycle with a low degree of simulation is one simplified with respect to one or more of the following aspects:

a) Number of environmental parameters,
b) Number of stress levels for the environmental parameters involved,
c) Number of possible modes of equipment operation, and
d) Sequence and combination of these parameters.

2.2.1 A cycle with a high degree of simulation is more complex and is closer to the actual use conditions, but is also more costly to realise and to perform by practical testing. A high degree of simulation is recommended when the outcome of the test is crucial, for example, when failure consequences are critical in terms of safety and economic loss, or in conflict with regulations, as with environmental pollution. Where failure consequences are less important, for example, in television and radio for entertainment, a low degree of simulation of use conditions may be used.

2.2.2 It shall be realised that the same type of equipment may be used in different applications, requiring testing to different test cycles. Furthermore, it is possible that, if failure consequences dictate, the same type of equipment may also be tested to different degrees of simulation.

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*Guide for equipment reliability testing:
Part 1 Principles and procedures.
Part 2 Design of test cycles.

2.2.3 In the case of a low degree of simulation, the test cycles have been simplified. However, the reproducibility and the repeatability of the tests are maintained with respect to the failure modes and the value of the reliability characteristic. It is expected that these will be consistent on different occasions and in different laboratories when testing the same equipment.

2.2.4 Reproducibility is also expected to be maintained between tests with different degrees of simulation, but the tests with a high degree of simulation will give results closer to the field reliability.

3. APPLICABILITY

3.1 The test conditions specified in this standard are applicable to the indoor portable equipments satisfying following conditions. However, this test cycle is not applicable to equipment with a reliability very sensitive to temperature and/or humidity values inside the ranges mentioned.

a) *Type of Equipment*	i) Portable equipment for stationary use. ii) Mass of equipment not exceeding 15 kg.
b) *Operating Conditions*	i) Operating only which in stationary position. ii) Moving and handling generally in the 'off' state. iii) Power supply from batteries and/or mains.
c) *Environmental Condition*	i) Indoors, during operation, moving and handling. ii) Usually protected if outdoors. iii) Ambient temperature normally between 19°C and 27°C with extremes seldom exceeding 13°C and 32°C. iv) Relative humidity between 36 percent and 54 percent, with extremes seldom exceeding 25 percent and 65 percent. v) Mechanical stresses: during moving and handling, principally shocks. vi) Dust, chemical pollutants, heat radiation, etc, may be present, but with limited concentration or intensity.
d) *Degree of Simulation*	Low

e) *Examples*

Equipment	*Conditions*
Small office machines	Office
Bench instruments, small domestic equipment	Laboratories, workshops, living rooms

4. RELEVANT PERIOD OF EQUIPMENT LIFE COVERED BY THE TEST CYCLE

4.1 This test cycle covers the activities of the tested equipment which occur during its normal use, with switching on and off, handling and transportation. Transportation from the factory to the site of use and long periods of storage are not taken into account in the test cycle. However, it is possible that the long-term reliability is sensitive to storage and transportation influences. If so, it is recommended that preparatory tests be performed (packaged where appropriate) on the same test items to simulate the effects of these phases of life on the equipment reliability. These preparatory tests cannot replace appropriate qualification tests of the packaging.

5. BASIC ASSUMPTIONS UNDERLYING THE SEVERITIES

5.1 Operating Conditions

5.1.1 *Supply from Mains* — Line voltage can normally vary by ± 10 percent, closer limits shall be considered, however, if stated in the equipment specifications. Voltage spikes from mains and power line interruptions can occur.

5.1.2 *Supply from Batteries* — Batteries are generally used from their fully charged state down to the lower limit of their charge. The minimum battery voltage during operation shall, however, be observed.

5.1.3 *Mode of Operation* — It is assumed that generally such equipments are in the 'on' state for only a few hours each day, with some switching on and off, and that in many cases they are not always in full operation while in the 'on' state.

5.2 Climatic Conditions

5.2.1 The equipment is deemed to operate in indoor conditions as described in **3**. These conditions are common in rooms with normal heating and ventilation.

5.2.2 Variations in climatic conditions may occur due to diurnal and seasonal variations in outdoor climate and due to regular or incident switching off and on of a heating or ventilating system.

5.2.3 It is assumed that the reliability of the equipment does not critically depend on the exact values of temperature and/or humidity, nor on the variations within the stated range.

5.3 Mechanical Conditions

5.3.1 Some mechanical stresses may occur during use when equipment is transported from one place to another, even if it is handled with reasonable care.

5.3.2 Very light equipments (up to 5 kg) are usually transported by hand. Shocks may occur when placing equipment on tables or shelves. Heavier equipment is generally assumed to be handled with more care, such as by means of small trolleys. The shocks are therefore considered to be less severe.

5.3.3 These stresses are normally applied to equipments when disconnected from the mains and in the 'off' state.

5.4 Other Conditions

5.4.1 The following conditions may apply, but have not been included in the test conditions because the degree of simulation is 'low':

a) Climatic conditions : Solar radiation, heat radiation and conditions of condensation;

b) Biological conditions : Mould and fungus;

c) Chemically active substances : Various gaseous air pollutants; and

d) Mechanically active substances : Dust.

5.4.2 Interference by electromagnetic fields of the level to be expected will normally influence the operation only momentarily without any long-term effect on the equipment reliability. It is therefore not included in the test conditions.

6. DESCRIPTION OF THE TEST CYCLE

6.1 Power Supply

6.1.1 *General Requirements*

6.1.1.1 Battery only operated equipment shall be powered by the specified batteries.

6.1.1.2 Mains-battery operated equipment is powered in alternate cycles from the mains and from the batteries; if the battery capacity is insufficient for the 24 h duration of the cycle, supply from the battery shall be limited to the time of power 'on' with full operation. During weekends and short duration holidays power should preferably be from the mains only.

6.1.2 *Supply from Mains*

6.1.2.1 The supply voltage has to vary as indicated in Fig. 1. The maximum value shall be within 7 to 10 percent and minimum value shall be within —7 to —10 percent of the nominal. If required in the equipment specification, closer limit shall be maintained.

6.1.2.2 Voltage spikes from mains and power line interruptions are not deliberately introduced, because the degree of simulation is 'low'. If the equipment is sensitive to voltage spikes then this shall be simulated.

NOTE — If the equipment reliability is not influenced by variations of line voltage and if allowed by the relevant specification, the programming of line voltage can be omitted.

6.1.3 *Supply from Non-rechargeable Batteries*

6.1.3.1 New batteries are inserted at the start of the test.

6.1.3.2 Batteries are replaced by new ones at the end of their useful life, or when their voltage drops under load conditions below the minimum values stated in the equipment specification.

6.1.4 *Supply from Rechargeable Batteries*

6.1.4.1 At the start of the test, batteries shall be fully charged.

6.1.4.2 Batteries connected as buffers to the mains supply are assumed to be automatically recharged during operation from the mains.

6.1.4.3 Batteries used as an alternative power supply shall be recharged during the times of operation from the mains, according to the detailed instructions given in the relevant specification. Batteries should always be checked under load conditions.

6.1.4.4 For equipment powered only from rechargeable batteries, it may be necessary to stop the test at convenient times, during 'off' periods, for battery recharging.

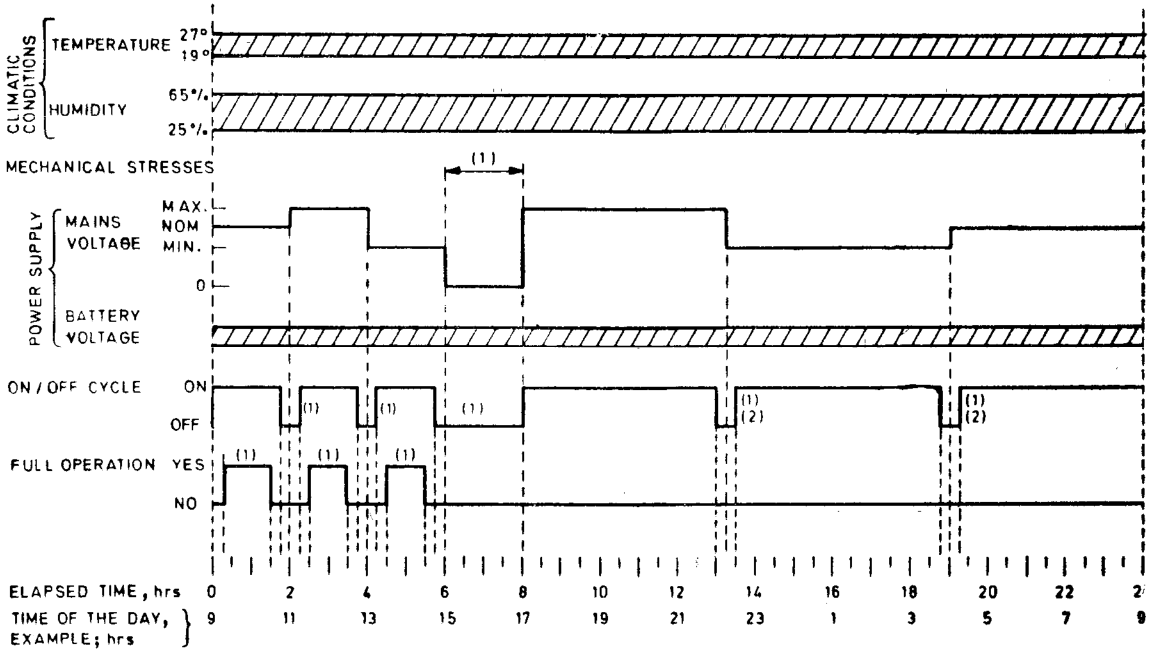
6.1.4.5 The relevant specification shall define whether the batteries are considered an integral part of the equipment and therefore whether the same batteries should be used during the full test.

6.2 Equipment Functional Modes

6.2.1 *On/Off Cycles*

6.2.1.1 These are performed as shown in Fig. 1 by means of the equipment on/off switch.

6.2.1.2 Cycles occurring during night hours may also be performed by means of external switches appropriately programmed.



NOTE 1 — May be omitted during week-ends and short duration holidays.

NOTE 2 — May be performed by means of external switches.

FIG. 1 DIAGRAM OF THE TEST CYCLE

6.2.1.3 The use of external switches is allowed in order to obtain a significant number of power on/off cycles without the need for attendance during the night. Small wiring changes of some equipment may be necessary.

6.2.1.4 Equipment intended to be continuously in the 'on' state, with periods of stand-by conditions and others of full operation (for example, television sets operated remotely by means of infra-red of ultrasonic signals) is subjected to the 'off' period of each cycle only when the line voltage is zero.

6.2.1.5 Manually operated 'on/off' cycles may be omitted during weekends and short duration holidays, with the specimens remaining in the 'on' state.

6.2.2 *Full Operation*

6.2.2.1 This shall be as described in the relevant product specification, in accordance with IS : 8161 (Part 1)-1976*.

6.3 Climatic Conditions

6.3.1 Ambient test temperature shall be from 19°C to 27°C. It should preferably not be constant at a value near the limits. Sudden changes of temperature should be avoided. The test relative humidity shall be from 25 percent to 65 percent. Except for temperature and humidity values and tolerances the relevant procedure of IS : 9000 (Part 3/ Sec 3)-1977†, or IS : 9000 (Part 3/Sec 5)-1977†.

6.3.2 Variations in climatic conditions are not included in the test conditions because the degree of simulation is 'low'.

NOTE — Care should be taken to avoid exposure to solar radiation, heat radiation, conditions of condensation, fungus, air pollution and dust.

6.4 Mechanical Stress

6.4.1 If not otherwise stated in the relevant specification, the test is in accordance with IS : 9000 (Part 7/Sec 4)-1979†, that is, 3 falls/ cycle from a height of 100 mm for equipment of up to 5 kg, 1 fall/cycle from a height of 50 mm for equipment over 5 kg. Specimens should fall, in the attitude of normal use, on to a concrete surface. They will be non-operating and in the 'off' state. For battery operated equipment, batteries shall remain in place during this test.

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*Guide for equipment reliability testing: Part 1 Principles and procedures.

†Basic environmental testing procedures for electronic and electrical items:

Part 3 Dry heat test, Section 3 Dry heat test for non-heat dissipating items with gradual change of temperature.

Part 3 Dry heat test, Section 5 Dry heat test for heat dissipating items with gradual change of temperature.

Part 7 Impact test, Section 4 Free fall.

6.4.2 Vibrations arising from a trolley or other means of transportation are not included in the mechanical test conditions because the degree of simulation is 'low'. For the same reason the conditions of shocks are considered only for equipment disconnected from the mains and in the 'off' state.

NOTE — If the equipment under test is to be moved, it should be handled with extreme care in order to avoid unintentional increases of the mechanical stresses corresponding to normally careful handling.

6.5 Permissible Modifications

6.5.1 Since this cycle is of a 'low' degree of simulation 2 out of 7 cycles a week may be modified by excluding those tests generally requiring manual operations. This modification is also allowed for short duration holidays during the test period on condition that no more than a total of 3 cycles are modified within any week.

7. RELEVANT TEST TIME

7.1 The general definition of relevant test time is given in **10.5** of IS : 8161 (Part 1)-1976*.

7.2 The relevant test time includes scheduled on- and off-periods according to Fig. 1. Downtime for repair, preventive maintenance or external battery recharge, are not counted as relevant test time.

7.3 Interruptions for re-setting up and transfer to a different test facility do not count as relevant test time.

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*Guide for equipment reliability testing: Part 1 Principles and procedures.

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IS :

8161	Guide for equipment reliability testing:
(Part 1)-1976	Principles and procedures
(Part 2)-1986	Design for test cycles
(Part 3)	Preferred test conditions for equipment reliability testing:
Sec 1-1986	Indoor portable equipment (low degree of simulation)
Sec 2-1986	Equipment for stationary use in weather protected locations (high degree of simulation)
(Part 4)-1985	Procedure for determining point estimates and confidence limits from equipment reliability determination tests
(Part 5)-1981	Compliance test plans for success ratio
(Part 6)	Tests for validity of a constant failure rate assumption
Sec 1-1983	Chi-square test
Sec 2-1987	Kolmogorov Simirnov test
Sec 3	Bartlett's test
(Part 7)-1977	Compliance test plans for failure rate and mean time between failures assuming constant failure rate
(Part 8)	Tests for the validity of a non-constant failure rate assumption
(Part 9)	Compliance test plans assuming Weibull distribution of time to failure
(Part 10)	Compliance test plans assuming normal distribution of times to failure
(Part 11)-1983	Flow chart describing preparations for the execution of reliability tests

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